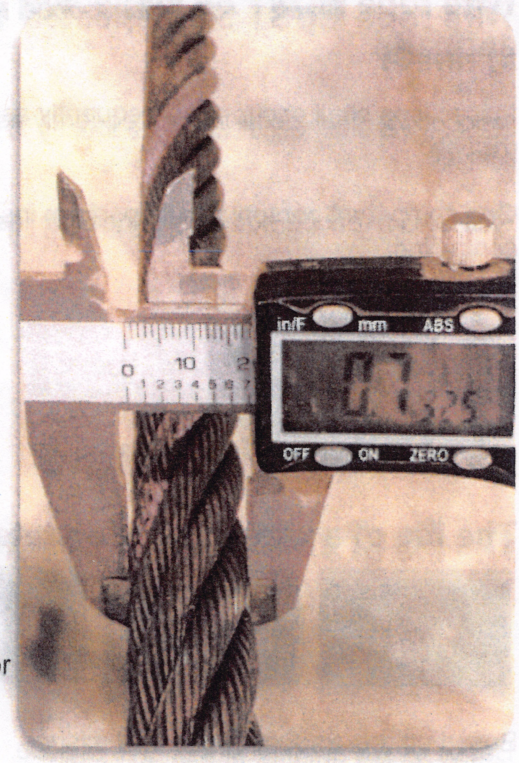
# Module 10
# Wire Rope Inspection




## Learning Objectives

By the end of this section, you will:

1. Know the information that is required in a log.
2. Understand when to replace wire rope.
3. Know the causes of wire damage and how to inspect for each type.
4. Understand the importance of wire rope lubrication.
5. Know the precautions to take when working with wire rope.
6. Know the proper unloading process.
7. Know how to calculate drum capacity.

### Inspecting wire ropes is one of the most important aspects of rigging.

Wire rope is one of the most used components of the crane and its rigging and is therefore one of the most susceptible to constant wear and tear.

Wire rope shall not be used if, in any length of 8 diameters, the total number of visible broken wires exceeds 10% of the total number of wires, or if the rope shows other signs of excessive wear, corrosion, or defect.

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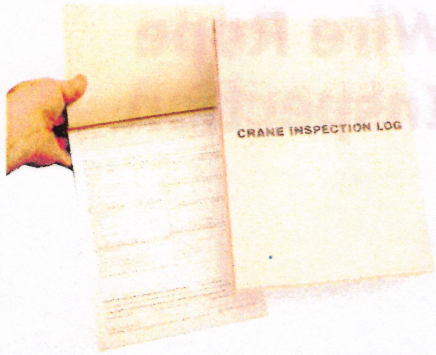
(c)(4)(IV)

### Wire rope inspection serves several purposes:

- **Helps to ensure safety.**
  - Any damage or significant wear must be considered a potential problem.
- **Identifies components needing to be replaced.**
  - It is required to know the condition of the equipment BEFORE operating the crane.
- **Provides advanced warning of possible breakage.**
  - Equipment failure or personal injury is the wrong way to find out.

## Wire rope MUST be inspected prior to each shift as well as monthly and annually.




Inspections shall occur more frequently as dictated by use and misuse.

One competent person should perform inspections and keep a log containing:

1. Inspection dates.
2. Length of service.
3. List of defects.
4. Replacement dates.
5. Any other significant information.

## The life of a wire rope is dictated by:

| Wear | Metal fatigue | Abrasion | Corrosion | Kinks | Improper reeving |
|---|---|---|---|---|---|

Based on the amount of use and misuse.
Daily attention should be paid to the condition of all wire ropes.

## The decision to replace wire rope varies and may be determined based on:

| Size, type, and frequency of lifts | Consequence of potential breakage | Inspection date |
|---|---|---|

All factors must be considered. Think safety and equipment damage at all times! Must decide when damage is enough to constitute a safety hazard. Don't just look in the obvious areas! Inspect the entire wire rope according to the type of inspection required.

## Wire rope used in continuous service or severe conditions should be replaced regularly regardless of external appearance.

The inspector must determine degree of rope deterioration. The total length of wire rope must be inspected.

# OSHA Inspection Criteria

**A competent person must begin a visual inspection prior to each shift the equipment is used, which must be completed before or during that shift.**

OSHA 1926.1413(a)(1)

**Inspection must consist of observation of wire ropes (running and standing) that are likely to be in use during the shift for apparent deficiencies.**

**"Apparent Deficiencies" have 3 categories. Category 1:**

- Significant distortion of the wire rope structure such as kinking, crushing, unstranding, bird caging, signs of core failure or steel core protrusion between the outer strands.
- Significant corrosion.
- Electric arc damage (from a source other than power lines) or heat damage.
- Improperly applied end connections.
- Significantly corroded, cracked, bent, or worn end connections (such as from severe service).

***Look up the removal from service criteria in Category II:***

OSHA 1926.1413 (a)(2)(ii)(A)

| Type of Wire Rope | Condition | Number ? |
|---|---|---|
| Running | Randomly distributed broken wires in one rope lay | 6 |
| Running | Broken wires in one strand in one rope lay | 3 |
| Rotation Resistant | Randomly distributed broken wires in 6 rope diameters | 2 |
| Rotation Resistant | Randomly distributed broken wires in 30 rope diameters | 4 |
| Pendant or standing wire rope | In one rope lay located in rope beyond end connections | >2 |
| Pendant or standing wire rope | In rope lay at an end connection | >1 |

**OSHA lists 3 apparent deficiencies in Category III:**

OSHA 1926.1413 (a)(2)(iii)

| Number | Deficiency |
|---|---|
| 1 | In rotation resistant wire rope, core protrusion or other distortion indicating core failure |
| 2 | Prior electrical contact with a power line |
| 3 | A broken strand |

**Wire ropes stretch during normal wear but excessive stretching indicates a need for replacement.**

**New rope is slightly oversized and will shrink to approximately the correct nominal diameter when the initial load is applied.**

**A diameter reduction of more than 5% from nominal diameter is cause for wire rope removal.**

OSHA 1910.1413(a)(2)(ii)(B)

## Damage to Wire Rope

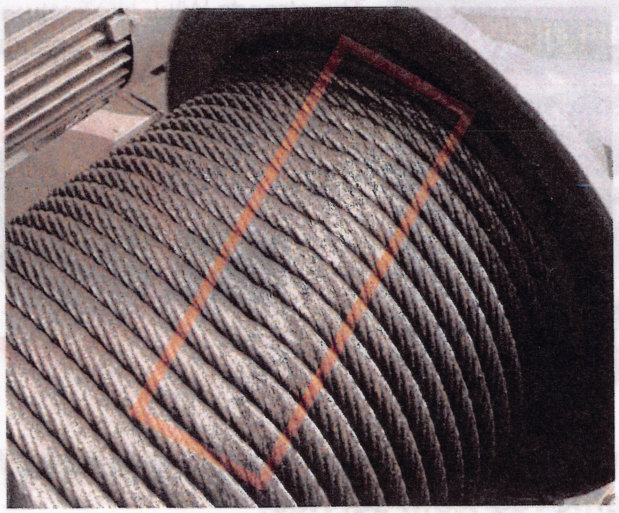
**Removal of wire rope because of broken wires depends upon the application of the wire rope.**

| | |
|---|---|
| Running ropes | • Exterior |
| Standing ropes | • Pendants & guy lines |
| Standing ropes | • Near fittings |
| Running ropes | • Valley breaks |

**Premature wear at numerous spots is a common occurrence.**

- Repetitive pick-up points.
- Top of wedge sockets.
- At drum flange.
- Crossover points.

**Inclined wear pattern from using a rope too small for the drum pitch.**

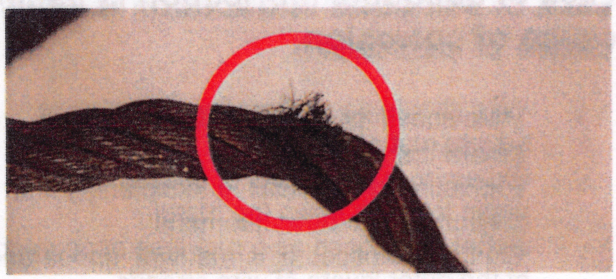


## Regular breaks are a cause for concern and typically indicate other problems.

Broken wires are common. Occasional or a few broken wires is no cause for concern. Finding a single broken wire, or even several over a wide area is acceptable. Categories of wire breaks depends on how the wire is being used. Replacement guidelines are defined by ANSI B30.5.

## Wire rope with a protruding core is permanently damaged and shall be replaced.

Protruding core is rope damage resulting from spreading of strands with core bulging out.



## Kinks are permanent distortions and the wire rope can not be returned to original strength.

Kinked rope has unequal load distribution at straightened section.

## Bird caging is a permanent torsional imbalance caused by:

- Pulling through tight sheaves
- Sudden release of tension and rebound of rope
- Sudden stops
- Rope wound too tight on drum

The strands WILL NOT return to their original positions and the wire rope is permanently damaged.

**Wire rope exposed to strong electrical current can have fused or annealed wires and must be removed from service.**

OSHA® 1926.1413(a)(2)(iii)(B)

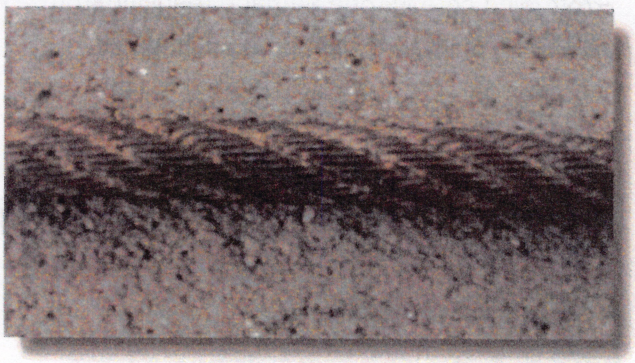
Whenever possible, the types of conditions discussed during the balance of this area should be demonstrated with actual sections of damaged wire rope. It is important that the operator actually see and be able to identify this type of condition. Wire rope damaged due to welding or that has been in contact with live power lines will generally display this condition. May actually show melting or fusion of wire sections. Can be caused by one problem or a combination of problems. Guidelines should be observed and correct replacement action taken.

Annealed outer wires

**Corrosion is more difficult to evaluate and more severe than normal wear.**

**Lack of adequate lubrication is usually the cause of corrosion.**

- Wire should be replaced when pitting or severe rust occurs.
- Exposure to chemicals or substances that begin to break down the metal.
- Generally noticed as a rust-type appearance of the outer layers of wire strands.
- Many times this begins on the inner wires before it shows on the outer wires.
- This can be determined by magnetic particle testing.
- Serious problem that usually leads to permanent damage and replacement of rope.



# Lubrication of wire ropes

**Wire rope is lubricated during the manufacturing process but initial lubrication is not sufficient to last the life of the rope.**

- Routine maintenance and lubrication of wire rope is essential or rope deterioration rapidly occurs.
- Lubrication of wire rope is as important as lubricating any other component or piece of machinery.
- Wire rope must be clean and dry before lubricant can be applied.
- Lubrication occurs only when lubricant comes in contact with bare wires.
- Excessive moisture gradually leaches out the internal lubricant.

**Wire ropes should be lubricated under working conditions with light mineral oil. Never use crankcase oil.**

**Good lubricants have...**

| | | |
|---|---|---|
| Corrosion resistance | Water repellency | Penetrating ability |
| Chemical neutrality | High pressure flow | Affinity for steel |
| Coating ability | Temperature stability | |

**OSHA also requires monthly and annual inspections of wire rope.**

***Who performs these inspections?***

» Monthly is performed by a competent person and the annual is performed by a qualified person.

***What is the major difference during the annual inspection?***

» Must include areas normally hidden during shift and monthly inspections.

***Does OSHA allow cutting of damaged wire rope?***

» Yes, but must still be long enough for two complete wraps to remain on the drum.

***Does OSHA allow splicing of wire rope?***

» No.

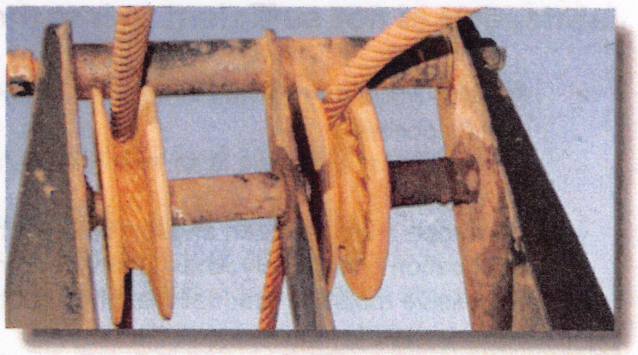
EXERCISE

OSHA 1926.1400 Subpart CC

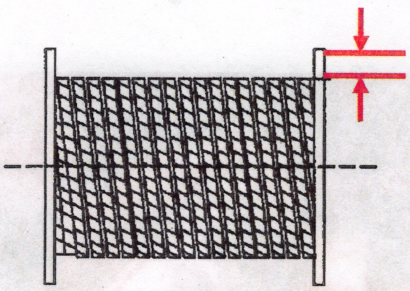
# Running rope

## Wire ropes running over drums and through sheaves will wear!

Generally noticed as a "rounding off" of the outer layers of wire strands.` It is important that the operator actually see and be able to identify this type of condition. Not easy to assess. Experience will often be an important factor in determining the appropriate amount of acceptable wear.



**Drum flange shall extend a minimum of ½ inch above the last layer of wire rope.**

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SETTING THE STANDARD

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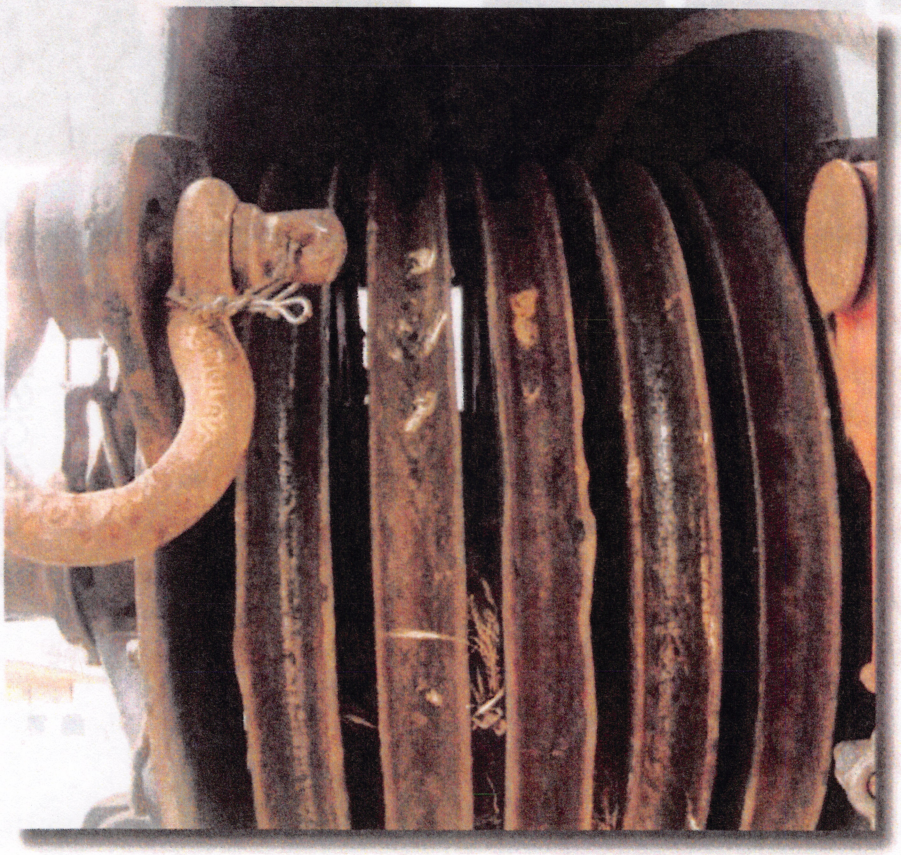
(a)(2)(-c)

**Damaged sheaves shall be replaced.**

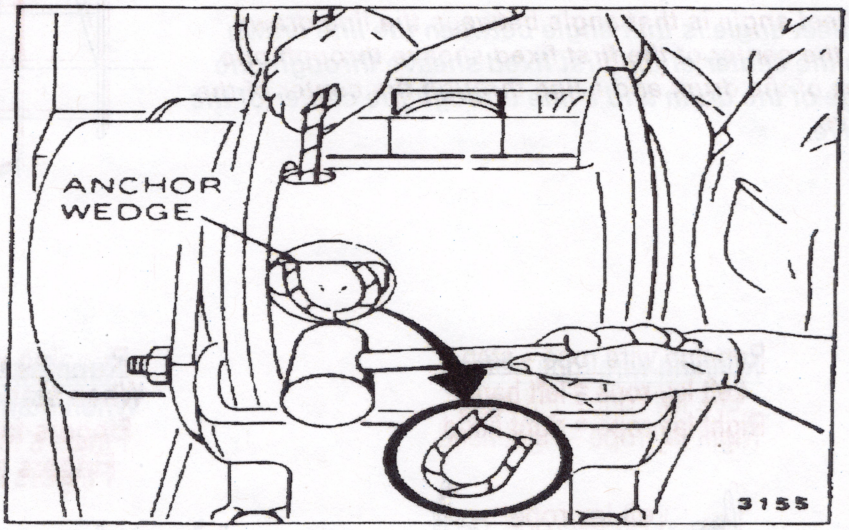


**No less than two full wraps shall remain on a drum during all service conditions.**

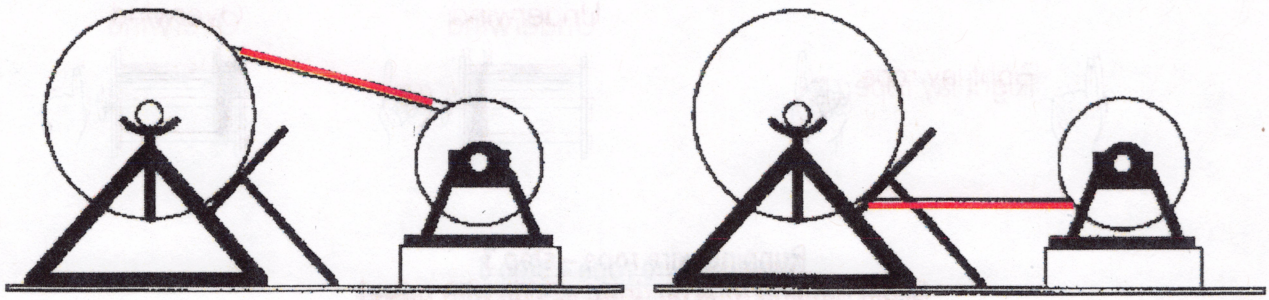
With the hook in its lowest position, there should be at least two full turns of rope on the drum.

**Cross over points on a drum shall be checked for wear.**

**The drum end of the rope shall be anchored, based on the manufacturer's recommendation.**




**Always reel from top-to-top or from bottom-to-bottom.**



When running wire rope onto a drum, make sure it bends in the same direction. Make note of the illustrations on this overhead.

Loose and uneven winding can create extensive wear, crushing, and distortion of the rope.

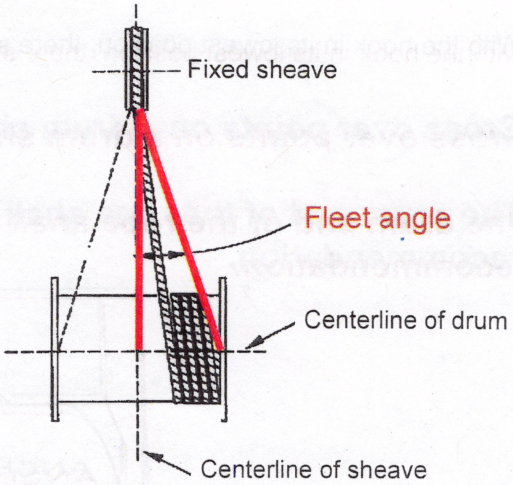
- Wire rope being wound from reel to reel or reel to drum.
- Top of one to top of other (or) bottom of one to bottom of other.
- Never cross wind wire rope from one position on one unit to the opposite position of another.

## The fleet angle is defined by measuring the outermost edge of the drum relative to the center line of the sheave.

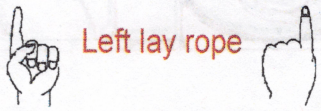
Due to the offsetting of a drum, the fleet angle on one side of the drum may be larger than the other.

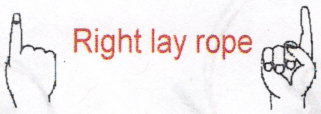
On grooved drums, fleet angle should not exceed 2 degrees (30:1 ratio). On smooth drum the fleet angle should not exceed 1-1/2 degrees (40:1 ratio). The larger of the two angles must be considered.

***The fleet angle is that angle between the line drawn from the center of the first fixed sheave through one flange of the drum and a line through the center of the sheave.***

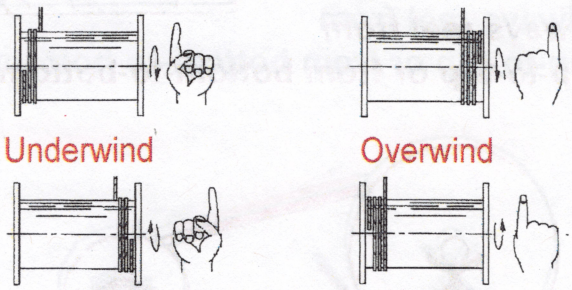



**Running wire rope – step 1**
**Left lay rope = left hand**
**Right lay rope = right hand**

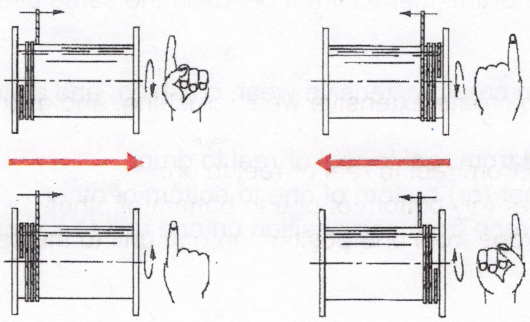



**Running wire rope – step 2**
**When standing behind drum:**
**Fingers facing = underwind**
**Fingers away = overwind**

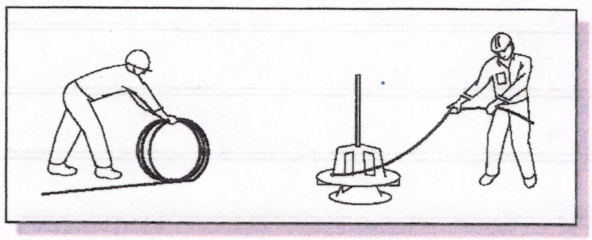



**Running wire rope – step 3**
**Begin running rope on drum at side with raised pointer finger.**

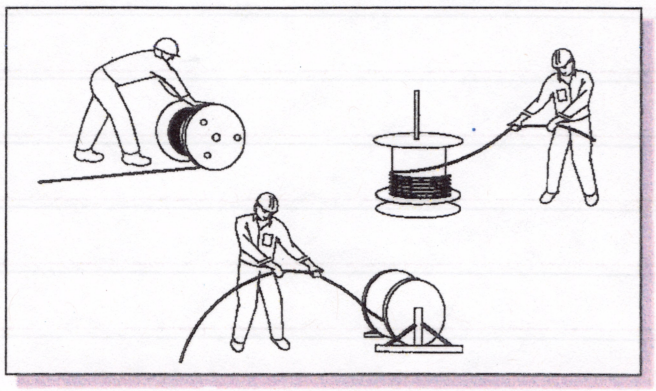


# Unwinding Rope

**The proper method for unwinding wire rope depends on whether it is stored on a reel or a coil.**



Unwinding wire rope from a coil.



Unwinding wire rope from a reel.

**It is important that the reel and coil rotate as the wire rope unwinds.**

Wire rope must be correctly handled during the unloading and installation to avoid kinking and causing permanent damage to the rope. The best method of handling a reel is to place a bar or shaft through the center of the reel and support the reel on jacks or blocks. Unwinding or uncoiling the wire rope from a stationary reel or coil will result in kinked wire rope that may be damaged beyond repair
A very expensive spool of wire rope can be turned into useless wire rope in a short period of time if not correctly handled. When in doubt, consult the manufacturer or someone who has experience in handling spooled wire rope.

Notes: